VIRTUAL HUMAN PERFORMANCE AND FIRE GROUND SURVIVAL

Dr. Ann-Maree Tedaldi
Tactical Performance Advisor, Seattle Fire Department

2021 Iowa Virtual Human Summit
September 2, 2021
TETRALOGY OF PERFORMANCE

Tactical Fitness
Sleep
Fuel (Nutrition & Hydration)
Thriveology

Proactive | Reactive | Rehabilitative
Tactical Fitness
- Tactical Fitness Appreciation Day
- B-Strong – Blood Flow Restriction Training
- But How Fit is Fit Enough?

Fuel
- Hydration Protocols – best guess??
- Nutrition Guidance specific to the demand
  - Recruit training vs. Station Meals

Sleep
- Beyond Education
- Situation specific challenges (Recruits)
  - Barriers to quality sleep.

Thriveology
Beyond Resilience
Mental performance
And so much more

SFD PERFORMANCE INITIATIVE

INTEGRITY   TEAMWORK   COMPASSION   COURAGE   DIVERSITY

Here to Serve since 1889
#1 Question: How fit is fit enough?

Candidate: If I can squat two times my body weight; is that a sufficient goal?

Let’s evaluate this question with a theoretical concept of “capacity”
1st – What is the Demand?

Seattle Recruit Training Demand:
• 2 bouts of 3 hours of work under load.
• 3-4 days a week

Cardio vs. Strength:
• Both are equally important, but without stamina (fatigue resistance) neither one will matter.

Capacity vs. Demand
Can this be quantified?

Caveat: Population (dept) Specific

Fitness considered equal, will anthropometrics influence capacity?
Theoretical Capacity Reserve (TCR)

TCR is what’s left in the “tank” for performing a skill/drill.

TCR = Total Capacity – consumption required to move mass

\[
TCR = 100 - \left( \frac{\text{Gear} + \text{Equipment}}{\text{BW}} \right)
\]

<table>
<thead>
<tr>
<th></th>
<th>Recruit A</th>
<th>Recruit B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight</td>
<td>200 lbs</td>
<td>150 lbs</td>
</tr>
<tr>
<td>Deadlift 2X BW</td>
<td>400 lbs</td>
<td>300 lbs</td>
</tr>
<tr>
<td>Full PPE + Hose Bundles</td>
<td>135.6 lbs + BW = 335.6 lbs</td>
<td>135.6 lbs + BW = 285.6 lbs</td>
</tr>
<tr>
<td>Theoretical Capacity Reserve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Mechanical Advantage/ Disadvantage of Anthropometrics?

<table>
<thead>
<tr>
<th></th>
<th>Recruit A</th>
<th>Recruit B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body weight</strong></td>
<td>200 lbs</td>
<td>150 lbs</td>
</tr>
<tr>
<td><strong>Deadlift 2X BW</strong></td>
<td>400 lbs</td>
<td>300 lbs</td>
</tr>
<tr>
<td><strong>Full PPE + Hose Bundles</strong></td>
<td>135.6 + BW = 335.6 lbs</td>
<td>135.6 + BW = 285.6 lbs</td>
</tr>
<tr>
<td><strong>Theoretical Capacity Reserve</strong></td>
<td>33%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Height - 1</strong></td>
<td>6’ 0”</td>
<td>5’ 7”</td>
</tr>
<tr>
<td><strong>Height – 2</strong></td>
<td>5’ 7”</td>
<td>6’ 2”</td>
</tr>
</tbody>
</table>

---

TCR continued...
#1 Question: How fit is fit enough?

Candidate: If I can squat two times my body weight; is that a sufficient goal?

*Let’s evaluate this question with a theoretical concept of “capacity”*

#2 Question: How can we reduce injuries?

Before we can mitigate injuries, we must understand them.

*All too often, “antidotal data” and extrinsic solutions drive mitigation strategies.*
STEPPING OFF APPARATUS

Assumptions:
• 3 points of contact is the answer
• Hands are always free
• Always facing the rig

Potential Covariates:
• Leaving rig with SCBA
• Step length and width are optimal
• Landing mechanics are optimal
• Adequate lighting
HOSE MANAGEMENT INJURIES

Assumptions:
• Adequate Mobility
• Proactive injury mitigation is not necessary.

Potential Covariates:
• Limited IR Rotation (very common)
• Poor Hip Flexion Strength
Fire Service and Virtual Human Performance
Improving Performance → Increasing Survival

- Science based hydration protocols
- Equipment and PPE
  - Design improvements
  - Effect on performance
- Quantification of occupational demands
- Informed training specificity
  - Capacity vs. Demand
- Explore anthropometric predictors of performance/injury
- Reducing the unsustainable rate and severity of injuries
Ann-Maree.Tedaldi@seattle.gov